AGRICULTURAL
Research
U.S. DEPARTMENT OF AGRICULTURE

FEBRUARY 1966

DO MOTHS USE RADAR?—Page 3

AGRICULTURAL
Research

February 1966/Vol. 14, No. 8

Protecting the Environment

Many people are concerned about the possible effects of agricultural chemicals on the quality of water flowing into our streams and underground supplies.

With no clear-cut answer at hand, ARS is stepping up work that will detect any effects on water quality and provide ways of eliminating them.

Research laboratories, such as the one planned for Durant, Okla., will be an important part of this search for knowledge. At Durant, our scientists will (1) determine whether and how water affects the movement of pesticides, nitrates and other fertilizers, and organic material; (2) develop management practices that will reduce to a minimum the movement of these materials into ground and surface waters.

Work at Durant will be tied closely to studies on erosion and runoff conducted at other ARS research centers, including Watkinsville, Ga. Scientists there know that ground cover can greatly reduce the amount of soil particles in runoff water. Since pesticides have a chemical affinity for soil particles, preventing the erosion of these particles could also keep the pesticide from entering water supplies.

Might it be possible, then, to use strips of sod to filter these soil particles out of water running off unprotected slopes? Research will tell.

Research and regulatory activities will also tell the story of pesticide residues. First-year results of pilot monitoring of the environment in the Lower Mississippi Valley show, for example, no progressive buildup of organic pesticides in soil, sediment, and water (AGR. RES., January 1966, p. 3).

ARS is continuing and expanding its monitoring, along with studies encompassing a fascinating variety of new, nonchemical weapons against pests.

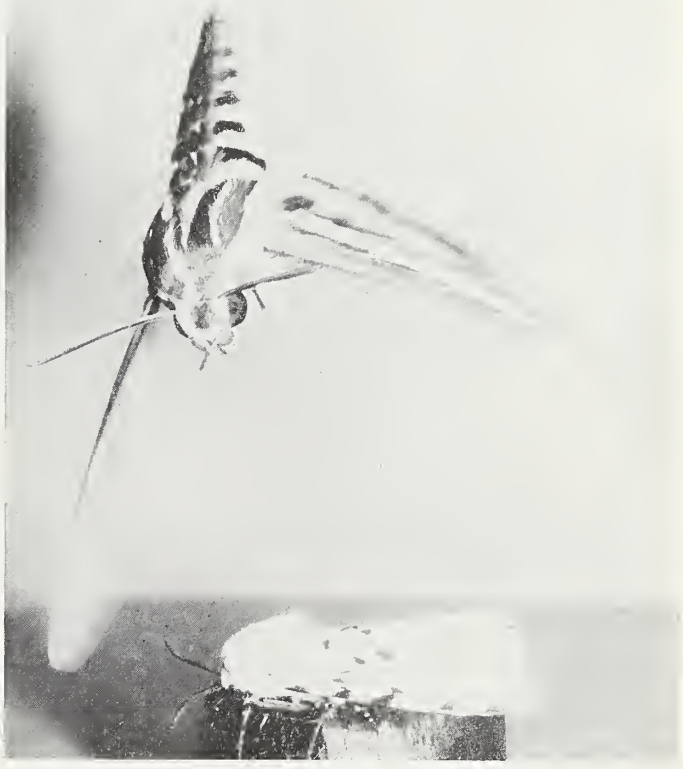
All of these efforts have one primary goal: To protect our abundant and wholesome food supply—without endangering water, wildlife, or man.

Editor: R. E. Enlow
Contributors to this issue:
R. J. Anzelmo, V. R. Bourdette, C. E. Bower, H. L. Brinson, E. H. Davis, D. W. Goodman, M. B. Heppner, J. G. Nordquist, F. J. Parks, J. M. Singer

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington, D.C., 20250. Printing has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is $1 in the United States and countries of the Postal Union, $1.50 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C., 20402.

Orville L. Freeman, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service



Antennae of a white-lined sphingid moth are equipped with thousands of sensing devices, resembling spines and pits. They may permit the insect to receive infrared signals transmitted by other insects of the same species and by certain plants. (Photo No. PN–1202)

DO MOTHS USE RADAR?

If signals can be simulated, research may have discovered a valuable new weapon against insect pests

Entomologists have been trying for decades to find out what kind of built-in system enables night-flying moths to detect mates or food sources over great distances.

Now an ARS scientist, P. S. Callahan, thinks he may have the answer—these moths, using a form of passive radar, can "home-in" on extremely feeble electromagnetic radiation given off by prospective mates and by certain plants.

This radiation, if it can be simulated, could become a valuable new weapon in insect control. It might be used, for example, as electronic bait to lure insects to traps, insecticides, or materials that will sterilize them.

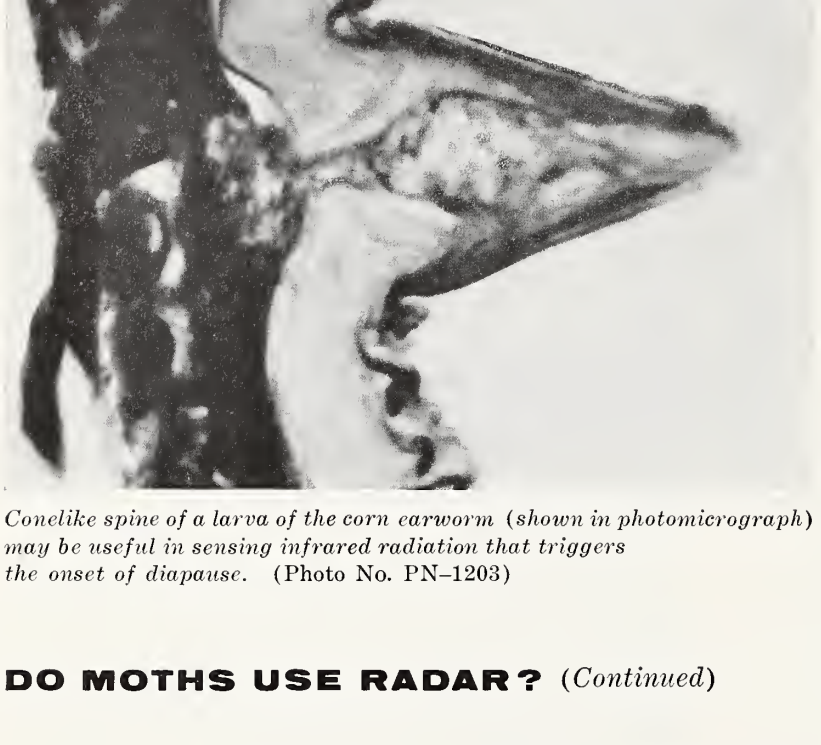
In research at Tifton, Ga., Callahan has shown that the night-flying moths he is working with—the corn earworm, fall army worm, and white-lined sphingid moth—are equipped with three kinds of radiation detectors. Two of these detectors, which look like spines and pits, are found in great numbers on the insects' antennae. A third type is located in the insects' compound eyes.

Moths use the spines as dielectric aerials. Because they vary in length, these aerials permit reception of frequencies of various lengths. Callahan says narrow-band infrared (IR) radiation is emitted by chemical molecules in the scent of the mates and of certain plants on which the moths feed. This radiation is picked up by the moths' spine-aerials, whether or not the insects come in contact with the scent molecules themselves.

Another type of detector, the antennal pits, consists of a sensor probe surrounded by picketlike spines. This apparatus helps moths locate mates by detecting broadband infrared radiation put out by other moths as body heat. Moths at rest tend to have the same body temperature as the surrounding air. But they can increase their body heat 8 to 18 degrees F. when the wings are vibrated. Such temperature changes are picked up by the antennal pits, even from great distances or at night.

The third sensing device, the compound eye, also responds to the radiation caused by changes in body temperature.

Callahan can demonstrate di-



Conelike spine of a larva of the corn earworm (shown in photomicrograph) may be useful in sensing infrared radiation that triggers the onset of diapause. (Photo No. PN–1203)

DO MOTHS USE RADAR? (*Continued*)

rectly, using an electronic device called a bolometer, that the test insects do emit radiation. Proving that other insects of the same species respond to these signals is more difficult. He does have what he considers to be indirect evidence of this response, however, in the form of photos taken of the eyes of moths. These photos show the eyes reacting differently under light in the visible spectrum than under IR light.

He also points to a number of natural phenomena that he thinks back up his theory. Light traps using ultraviolet lamps in the field catch fewer insects on moonlight nights than on dark nights. Callahan thinks this is because the moon is a powerful source of IR and causes interference, thus "jamming" the light traps. Insects have difficulty finding food and mates in rainy or humid weather. Moisture, Callahan contends, reduces IR reception by the insects—especially those with aerial-shaped insect spines—just as it does in many manmade aerials.

Callahan's next task is to reproduce artificially the IR and microwave signals produced by the moths. If he succeeds, he may be able to prove his theory by getting the test moths to respond to the artificially produced stimuli.

Callahan thinks his theory may explain a number of riddles in nature. For instance, he feels that diapause—a temporary halt in an insect's development—may be triggered by a reaction to IR radiation instead of to shorter days in the fall. He cites the corn earworm larva, which lives inside plant parts unexposed to daylight and still enters diapause on schedule. Diapause, he theorizes, occurs in this case because the larva's spine-aerials pick up IR radiation penetrating the plant and transfer the radiation to the nervous system.

IR radiation may also permit parasites looking for food on the outsides of plants or trees to detect the presence of larvae inside. The larvae emit radiation at certain frequencies which are received by the parasites.☆

Improved crop varieties go quietly about their work as . . .

Silent Servants

■ Widespread achievements by plant breeders would be more apparent if growers of improved varieties installed small signs in fence rows that read something like this:

Here grows Pickett, a new soybean variety that resists that blasted cyst nematode

Once a new variety becomes established, its silent service to mankind goes on—but often unheralded. Built-in resistance to disease and insects, cold and drought, is not seen from the roadside. Neither are improved quality and the increased ability to make more efficient use of soil moisture and fertilizer.

About 80 new varieties or breeding lines are released jointly each year by ARS and State agricultural experiment stations; many others are released separately by States and by commercial companies. They range all the way from field crops to grasses for golf greens, from potatoes to ornamentals.

Even less conspicuous are the research-developed genetic tools used in breeding new varieties. Alfalfa breeding material is available, for example, that has resistance to four pests.

Working in cooperation with the Nevada Agricultural Experiment Station, ARS scientists have developed a breeding line of alfalfa that resists

ARS plant breeder Vogel checks a sample of Gaines wheat, a variety which he developed. Although of proven value to Pacific Northwest wheat growers, Gaines will soon be replaced by Nugaines, another Vogel-developed variety with superior milling quality and test weight. (Photo No. PN–1204)

pea aphids, spotted alfalfa aphids, bacterial wilt, and stem nematodes. This line, designated N–529, was released to plant breeders last fall for use in breeding new varieties or hybrids.

But breeding for resistance to pests is a continuous battle. On one side is nature's creation of new pests or new forms of old pests. On the other side is man's search for varieties that will resist attack by these pests.

Development of corn lines that resist maize dwarf mosaic and corn stunt illustrates the problem. These two virus-caused diseases first appeared in 1962—corn stunt in Mississippi and maize dwarf mosaic in Ohio. One and possibly both of these diseases have spread and become more severe since they were first reported: Maize dwarf mosaic is known to be in most Midwestern and some Southern States; corn stunt has been positively identified in only a few cases, but it is suspected as the cause of stunting in scattered areas throughout the Southern States.

Resistant lines seem to offer the best means of controlling these diseases. The new inbred corn lines—two with resistance to corn stunt (M_p462 and M_p488) and two with resistance to maize dwarf mosaic (Oh7k and Oh422)—are the result of extensive screening studies and breeding work by ARS and the Ohio and Mississippi Agricultural Experiment Stations.

Another advance in breeding for pest control is illustrated by Pickett, the first yellow-seeded soybean variety having resistance to the cyst nematode. This pest, first identified in North Carolina in 1954, damages soybeans in Virginia, North Carolina, and the upper Mississippi Delta area.

Pickett's resistance to the cyst nematode originated in Peking, a black-seeded variety. To obtain yellow-seeded soybeans required for oil and meal production, plant breeders crossed Peking with Lee, the most widely grown yellow-seeded variety in the Southeast. After several years of backcrossing to Lee and related strains, a few resistant yellow-seeded lines emerged. One of these, Pickett, was released to certified seed growers in 1965 and should be available for planting in 1967.

Plants for beautification as well as crops for food, feed, and industrial use, are being improved through breeding. Here are some of the new varieties and lines released in 1965:

GRASS—Tifdwarf, a new bermudagrass that should simplify the care of golf greens. This dwarf grass has been rated equal or superior, on all counts, to Tifgreen, now the top golf-green grass in the South.

POINSETTIA—Spring Pink, introducing a new choice in color. This variety has bracts of uniform pink and notched foliage of medium green.

SNAP BEAN—Yakima, the first commercial snap bean variety with good resistance to curly top. The variety is well adapted to mechanical harvesting and well suited for home gardens, fresh market, freezing, and canning.

CORN—B64, an inbred line of yellow dent corn that has a high level of tolerance to larvae of the western corn rootworm, one of the most destructive insects attacking corn throughout the Midwest. The line was released to plant breeders for use in developing tolerant or resistant hybrids.

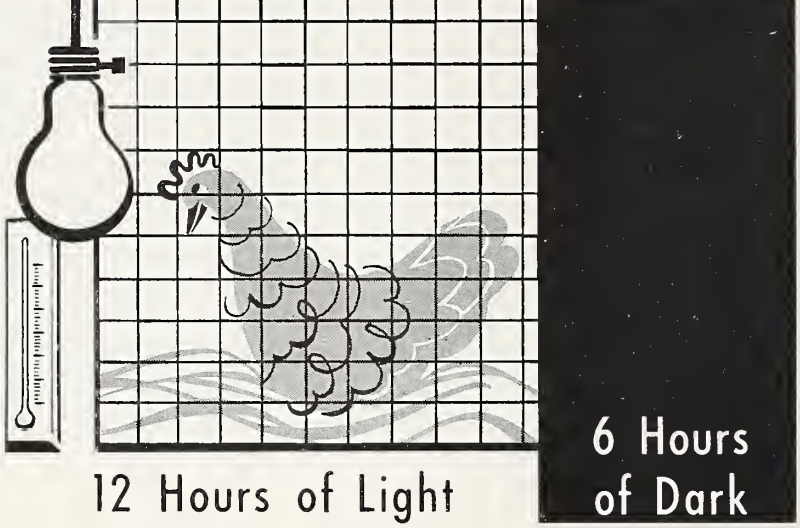
WHEAT—Nugaines, a white winter pastry wheat with short straw for the Pacific Northwest. The new variety yields the same as Gaines, widely grown in the Pacific Northwest, but it has superior milling quality and test weight.

LIME—USDA Persian, a new selection that is free of viruses commonly present in old-time Persian lines.

COTTON—Hopicala, a new variety that has a wide range of adaptability in the West. It has excellent fiber qualities and a moderate degree of tolerance to verticillium wilt.☆

An 18 Hour Day for Layers

Scientists test genetically selected flock on a 486.6-day year



Scientists at Beltsville, Md., are trying to make a flock of chickens think day changes into night every 18 hours. If they can do this, chickens would have 486.6 short days per year in which to lay eggs, instead of the conventional 365.

Although it is too early for results, the flock on 18-hour days so far is holding its own against birds on a 24-hour schedule.

ARS poultry scientists use an artificial lighting system—part of a larger network of environmental controls—to change light into darkness inside an experimental henhouse every 18 hours. They expose a genetically selected flock to 4 short days, instead of three conventional days, during every 72-hour period.

Commercial poultrymen began lighting houses artificially several years ago, after noting that hens lay extra eggs in spring and summer when days become longer. But they normally keep total day length at 24 hours and vary only the ratio of light to darkness—typically 16 hours of light to 8 hours of darkness—the year around.

Behind the ARS effort to shorten the chicken day lies the fact that today it takes a good hen about 24 hours to produce an egg. And so, like many body processes, egg production appears tied to the rhythm of day and night.

ARS poultry geneticist H. L. Marks, in charge of the short-day project, reasons that a more rapid day-night rhythm might allow chickens to accelerate their production. In other words, some chickens with the proper genetic potential might be conditioned to lay an egg in an average of about 18 instead of 24 hours.

To see if this theory works, ARS farm electrification engineers L. M. Lucas and L. E. Campbell helped poultry scientists in equipping an experimental henhouse. For lighting control, they installed time clocks which provide 12 hours of light alternating with 6 hours of darkness, thus paralleling the 2: 1 ratio of 16 hours light to 8 hours darkness that many poultrymen use. Also, they devised an air-conditioning unit that keeps the chickens warmer (by 10 to 15 degrees F.) when it is light than when it is dark. This equals the difference in outside temperatures between day and night.

Several generations of chickens—from parent stock that varied considerably in genetic makeup—have been selected for improved egg production on 18-hour days and compared with a similar flock working regular 24-hour days. So far, both groups have improved from generation to generation at about the same rate.

Selection for high lay generally improves egg production up to a point, after which it levels off. Since both the short-day chickens and the controls are still improving, it is too early to say whether the experiment will produce the hoped-for results. The true test of the 18-hour day, in other words, is in the question: Will hens on short days keep on improving their egg production after those working regular days level off?

If the answer is yes and strains that produce well on short days can be established, poultrymen may have to keep them in windowless houses installed with time clocks similar to those used by ARS researchers. It is possible, however, that these strains will continue to lay at a high level, even when exposed to conventional lighting. Several more years of research will be necessary before the scientists can say whether either method will help the commercial egg producer.☆

Reclaiming Sunlight

White plastic reflects 80 percent of light back up on corn plants for use in photosynthesis

■ Spreading opaque-white plastic sheets between rows of corn increased yields by intensifying the light available for photosynthesis in ARS-Illinois tests.

Agronomist J. W. Pendleton of the University of Illinois and ARS soil scientist D. B. Peters spread sheets of 4-mil polyethylene between rows when the corn was 12 inches high and left it there until harvest.

The plastic reflected over 80 percent of the light striking it—in effect, reclaiming sunlight that would normally be absorbed by the soil and making it available to plants for additional photosynthesis. Light is the energy source plants use in photosynthesis to convert carbon dioxide and water to sugar, starch, water, and oxygen.

Basic research into the effect of increased light on plant growth is important to understanding the plant life cycle and for determining the best spacing for crop rows and plants in the rows. Increased yields in these tests—an average 21 bushels per acre—were not sufficient to pay for the plastic used to intensify the light.

The researchers set up conventional untreated check plots and plots on which they had spread black polyethylene between rows of corn. They used black plastic—which reflected only 3 percent of the light striking it—to differentiate between results due to moisture-retaining characteristics of plastic mulches and those due to the light-reflecting color of the plastic.

A large, single-ear variety of corn was planted in shallow furrows 40 inches apart at a rate of 16,000 plants per acre. The test plots were located on Flanagan and Catlin silt loam. Ridges between the rows sloped so that rainfall would run onto the plants.

Plots treated with white plastic consistently yielded more than check plots; they averaged 21 bushels per acre more than plots receiving no treatment and 20 bushels more than those treated with black plastic.

The researchers assume that the yield increase from black polyethylene—1 bushel—was caused by soil-moisture conservation and that a like increase could be attributed to the white polyethylene. Of the 21-bushel increase, therefore, 20 bushels are probably the result of increased light and 1 bushel the result of moisture conservation.

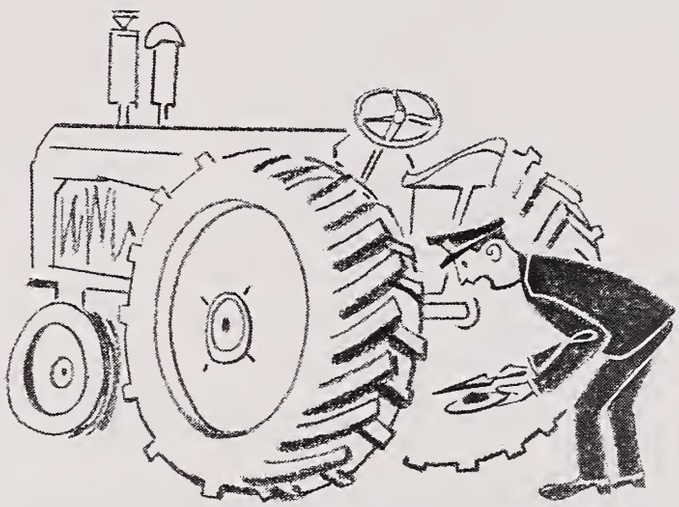
Increases in soil temperature caused by the plastic probably exerted little effect on yield, Pendleton and Peters concluded. They measured temperatures at the soil surface and at 2 and 4 inches below the surface and found them 1 and 5 degrees warmer at the surface under the plastic than on bare plots but substantially the same at the 4-inch depth. No significant differences existed in air temperatures between plots.☆

Soil scientist Peters arranges sheets of white polyethylene plastic between rows of young corn to intensify the reflection of light onto the plants. (Photo No. PN–1205)

QUIRKS ON THE QUARAN

The difficult job of protecting our Nation's resources has, at times, a lighter side for ARS quarantine inspectors, who form our first line of defense against damaging foreign pests.

As they examine baggage and cargo at ports of entry, the inspectors encounter unusual and sometimes humorous incidents in an atmosphere of serious business—that of keeping hitchhiking plant pests from entering the United States in fruits, plants, and souvenirs:



• An English exporter offered to eat any soil found on his tractors when they arrived in Seattle. The shipment looked clean, but inspectors found nearly a pound of soil containing oat cyst nematodes on a single tractor. The exporter had to eat his words—but not the soil. (Photo No. PN–1206)

• A plant quarantine inspector in San Pedro, Calif., looking for pests in bird seed wondered why the cage contained fresh water and seed—but no bird. The woman passenger repeated only, "No speak English." Then a parakeet the woman had stuffed under her coat let out a loud squawk. Woman and bird were turned over to the Public Health Service. (Photo No. PN–1207)

• A 7-foot tiki almost got the ax at San Ysidro, Calif. Carved from a palm stump with roots as the hair, the idol was not allowed to enter the United States until its youthful owners removed all soil from the roots. (Photo No. PN–1208)

• An inspector in Seattle broke up the friendship between a member of a ship's crew and his pet grasshopper. The grasshopper belonged to a species that causes destruction in China and Japan but is not found in the U.S. (Photo No. 1213)

INE LINE

← • Although some people fail to cooperate, a few go overboard. A yacht captain in Miami dived after a lemon he had thrown into the water when he learned that damaging plant pests could invade Florida in fruits and plants from other countries. (Photo No. PN–1209)

• To avoid giving up his apricots in Chicago, one traveler began eating them. The passenger turned a sickish green after the inspector broke open one apricot and revealed insect larvae inside. (Photo No. PN–1211) ↓

↑ • An obviously nervous woman whispered to an ARS inspector in Dallas that she suspected there was a bomb in her carryall bag. The bag was vibrating and the inspector, thinking a large, buzzing insect was hiding in it, opened the bag to find that the woman's electric toothbrush had accidentally switched on. (Photo No. PN–1210)

→ • Golf shoes were found playing host to a party of plant parasites upon their arrival at Dulles International Airport, near Washington, D.C. Soil adhering to the shoes yielded the grass cyst nematode that attacks lawns and pastures in foreign countries. Undetected, the pest could have started an infestation on some luxurious greens in this country. (Photo No. 1212)

Soybean stems with pith rotted by the disease (left and center) contrast with a healthy stem (right).

Soybean leaf shows symptoms of brown stem rot. (Photo Nos. left to right, A–27035 and A–29372)

DON'T FORGET CROP ROTATIONS

Pathologist traces increase of brown stem rot of soybeans to intensified cropping

Increasing problems with brown stem rot of soybeans in the Midwest may be closely related to changes in cropping accompanying the rapid increase in soybean production.

ARS plant pathologist J. M. Dunleavy, who is studying brown stem rot in Iowa, found that the disease affected 6 percent of that State's soybean fields in 1956 and 53 percent in 1964. During this period, Iowa farmers increased soybean acreage from 2.5 million to 4.1 million. ARS is conducting research in cooperation with the Iowa Agricultural Experiment Station to see if a relationship exists.

Brown stem rot, reported in Illinois in 1944 and in Iowa in 1948, was at first confined to the Midwest. But in recent years it has been found in Florida, North Carolina, and Virginia.

At present, there are no known resistant varieties; crop rotation is the only way to combat the disease.

Dunleavy suggests that the increase of brown stem rot in Iowa may be caused by a gradual shift from a rotation like corn-soybean-oats-meadow to one limited to corn and soybeans only. Bordering corn fields with soybeans and reducing distances between soybean fields may also contribute to the increase.

Brown stem rot, a vascular disease of soybeans, is caused by a soil-borne fungus. Once the fungus contaminates a field, it cannot be eliminated economically by any known means, even if soybeans are grown in rotation with nonsusceptible crops. But the number of infected plants is reduced if soybeans are grown in a given field not more than once every 3 or 4 years.

To study the effect of the disease on soybean yields, Dunleavy contaminated test plots, planted them with soybeans for 2 consecutive years, then compared yields with adjacent uncontaminated plots. The contaminated plots yielded 9 percent less the first year and 20 percent less the second year than the uncontaminated plots.☆

WHAT ABOUT FESCUE FOOT?

■ ARS and other scientists are studying a cattle disorder called fescue foot, which may occur in beef or dairy animals grazing tall fescue.

Fescue foot was first reported in the United States in 1952. Since then, scattered reports of the disorder have come from most of the States where tall fescue is grown extensively—Tennessee, Kentucky, Missouri, and parts of adjacent States. In these areas it is a good grass for pasture and conservation purposes.

Scientists have found that fescue foot is more likely to occur on low, wet fields, but they also observed the disorder in Kentucky and Missouri in the winter of 1963, a dry year with low forage supplies. During winter months, cattlemen were allowed to use for grazing soil-bank land on which the accumulated forage was low in quality and nutritive value. Affected animals were observed on some of this land. When removed from the pastures and provided with other sources of feed, the affected animals usually recovered.

Fescue foot has also been observed in midsummer on well-managed fields, especially when cattle are confined for long periods to tall fescue pasture. But under normal grazing conditions when cattle are rotated to various types of pasture throughout the year, fescue foot generally causes no problem. All tall fescue varieties, including the newly released Kenwell, can cause the disorder.

For a number of years, fescue foot probably went unnoticed or was confused with foot rot or ergot poisoning, which it resembles. An early symptom of the disorder is a drop in beef gains or milk production. This is followed by weight loss, lameness of the rear quarters, and loss of coordination. In extreme cases, the rear hooves crack and slough off, the animal may lose the lower part of its tail, and it may die.

As with tall fescue, toxic properties sometimes develop in forage and pasture plants and cause disorders in cattle. Some of the better known of these toxic properties include poisonous hydrocyanic acid in certain grasses; substances in leguminous plants that cause bloat; and nitrate toxicity.

In tall fescue, the toxic substance is not known. But cooperative research by ARS and agricultural experiment stations in the States involved indicates it causes a restriction of the blood supply to the animal's hind quarters. Scientists note that lameness and sloughing off of the hoof most often affects the left hind quarter.

If removed from tall fescue at the first sign of lameness, cattle usually recover completely. At present, the removal of affected cattle from tall fescue is the only known cure.

Tall fescue is a valuable grass for conservation and experience shows that it can be grazed with little expectation of serious trouble. Even so, scientists say that farmers should watch carefully for symptoms while their animals are grazing on tall fescue. And the animals should be moved to other sources of forage if any symptoms appear.

Research now in progress seeks the exact cause of tall fescue poisoning and a better remedy or measure to control it.☆

Stricken with fescue foot, this Holstein lost weight and experienced a lack of coordination in the hind quarters. In advanced stages, rear hooves may crack severely or even slough off. (Photo No. PN–1216)

First Came Systemics, Now A Way To Apply Them

■ Entomologists have protected cotton plants against insect damage by applying a systemic insecticide to the stems (AGR. RES., November 1965, p. 12). The insecticide is absorbed by and moves within the plant.

The technique looked promising, but its developers knew it had little practical value as long as there was no way to apply the material on a field scale.

Now, however, engineers have built and tested a tractor-mounted machine in Texas that applies a narrow band of insecticide to stems of cotton plants just above the ground level. With the new applicator, scientists have a method for efficiently treating entire fields.

ARS and Texas Agricultural Experiment Station scientists developed the unit, which includes some design features originated by ARS scientists at Tifton, Ga.

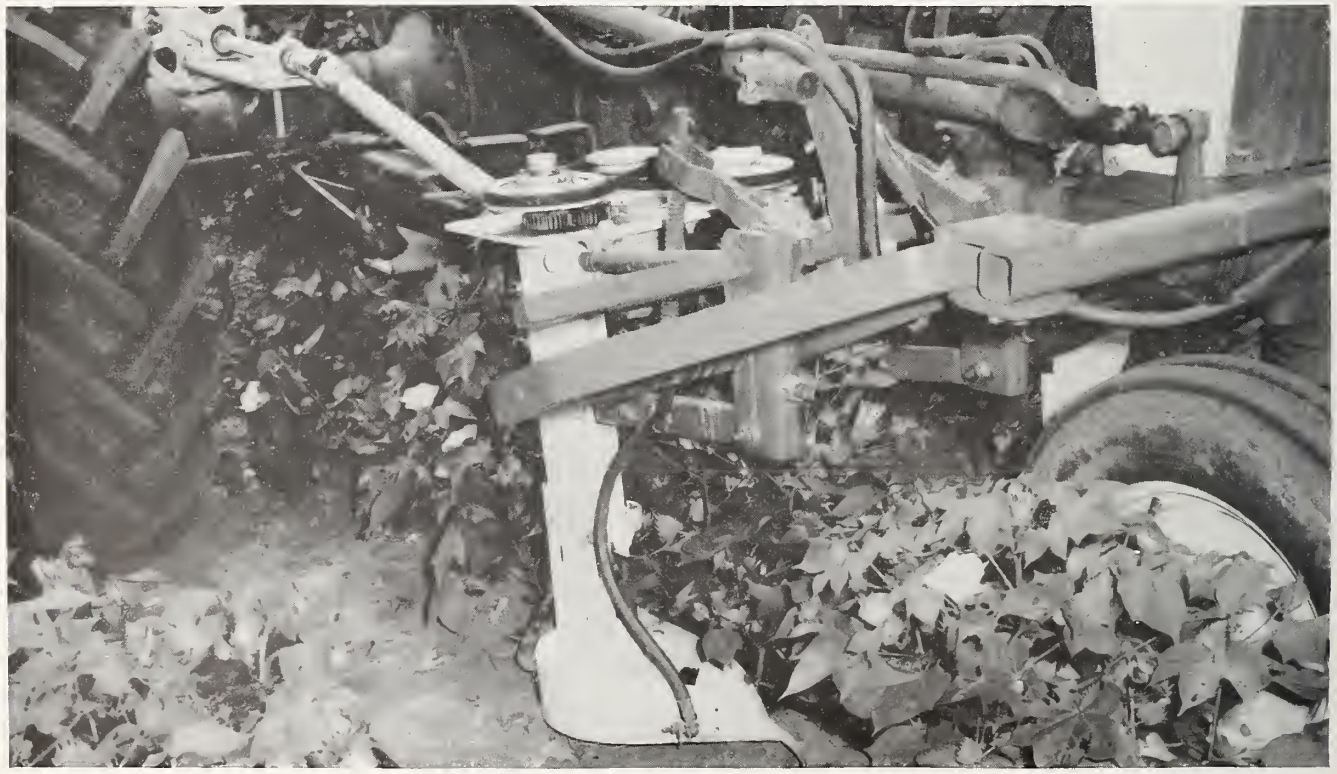
The new applicator guides cotton stalks between two continuously rotating brushes that mesh with each other. The insecticide, which has a thick siruplike consistency, is sprayed onto one of the brushes for transfer to the stalk.

Both brushes are enclosed in a shield (see photos) which protects against weeds and dirt clods and which lifts leaves away from the area of application. Two units, operated from the tractor's power takeoff, are mounted on either side of the tractor where they treat two rows of cotton simultaneously.

Considerable effort has gone into developing systemic insecticides because they are selective against insects attacking a specific crop, thus reducing hazards that may be involved when conventional sprays are used. Although some systemic chemicals must be applied to foliage to be effective, most of them can be applied to other parts of the plant, to the seed, or to the soil.

When testing the stem applicator, the scientists found that most of the insecticide adheres to the plants, virtually eliminating the danger of toxic material drifting to nearby susceptible crops or entering the soil to remain as residue. In addition, there are no residues on the foliage to harm beneficial insects that may visit the plant.

Stem application has the added advantage that it can be used under conditions unsuitable to other treat-



ments. Side dressing is not effective, for example, on certain soil types or when there is insufficient soil moisture.

The applicator worked best in cotton that had been treated with a herbicide for weed control and that had been flamed to remove lower leaves. It was effective, however, in combination with a wide range of cultural practices.

Scientists are now trying to find ways to make systemic insecticides release their toxicity over a longer period of time. They hope to develop slow-release formulations that, through a single stem application, would protect plants throughout the entire growing season.

Besides applying insecticides, the scientists believe the applicator can be used to apply systemic fungicides, plant hormones, and defoliants.☆

LEFT—A side view of the rotary brush insecticide applicator reveals its frame and part of the drive mechanism. (Photo No. PN–1217)

BELOW—The applicator's plant guides, shields, and rotary brushes are visible in a front view. (Photo No. PN–1218)

Toward: A More Uniform Blend of Cotton

Textile processors may soon be able to blend cotton from as many as 20 different bales at once with a new machine developed by ARS scientists. Tests of a small-scale model at the Southern utilization research laboratory in New Orleans have been so successful that a full-size unit is being constructed for actual mill trials.

If proved practical, the machine should fill industry's growing need for a way to blend cotton more efficiently. This need arises from improvements in other cotton processing machinery, as well as new consumer and industrial requirements for uniform fiber properties in the finished product. Fiber characteristics vary from bale to bale and significantly affect processing efficiency and product quality.

Laboratory evaluations of the experimental unit are encouraging. They indicate, for example, that the full-size machine will produce up to 1,000 pounds, or 2 bales, per hour and will deliver thoroughly blended cotton in any desired proportion.

The blender also has other characteristics considered necessary in a good blender. Among these are the ability to remove from the bale and deliver to a conveyor system tufts of cotton at controlled weights of one-tenth to one-half gram, and to process the entire bale without waste. The blender requires less floor space than machines now used to open or fluff tightly packed cotton.

For a 20-bale blend, one layer from each bale is used to form a "sandwich" bale. The composite bale is fed into the blender, where toothed cylinders moving rapidly up and down pull tiny tufts of cotton from the end of the bale at any desired rate. In this manner, the machine can process enough cotton each hour to make 4,000 square yards of high-quality fabric.

In operation, the experimental machine blends cotton from as many as 20 different bales at once. (Photo No. PN–1219)

Planned tests of the full-size unit should furnish complete information on machine performance and product quality. The blender's developers, J. I. Kotter, H. L. Salaun, E. F. Wallace, J. P. Lanigan, and R. A. Rusca, will then compare the data they obtain with that from conventional blending.

In its present form, the blender is automatic except for the preparation of the "sandwich" bale which must be stacked by hand. However, if results of the mill trial prove the blender successful, work will begin on an automatic sandwich bale stacker.☆

Mechanizing Hawaii's Coffee Harvesting

Equipment is being developed that could mechanize Hawaii's coffee harvesting—a hand-labor job that has not changed in all the years that coffee has been a crop.

Agricultural engineers G. E. Monroe of ARS and J. K. Wang and F. A. Shellenberger of the Hawaii Agricultural Experiment Station are working on harvesting equipment which, when perfected, will vibrate coffee cherries off the trees and convey them into containers without harming either the fruit or the tree.

If the experimental system proves successful, growers could increase production of Hawaii's third largest export crop (next to pineapples and sugar), while halving the cost and labor required for harvesting. Coffee picking presently consumes about 70 percent of the total labor needed for production.

Developing efficient harvesting machinery has been difficult, primarily because of the steep slopes and rough, rocky terrain where Hawaiian coffee trees grow. The necessity for picking only mature fruit and the closeness of the trees (4 to 8 feet apart) are added problems.

A dynamically balanced experimental shaker was designed and tested during the 1965 harvest season at vibrating frequencies ranging from 2,700 to 3,500 cycles per minute and at a stroke of one-half inch.

The best operating frequency, the engineers say, yielded about 85 percent mature and 15 percent green fruit. Mature fruit separation was better at the higher frequencies; immature fruit separation depended more on the force of the shaker than it did on frequency.

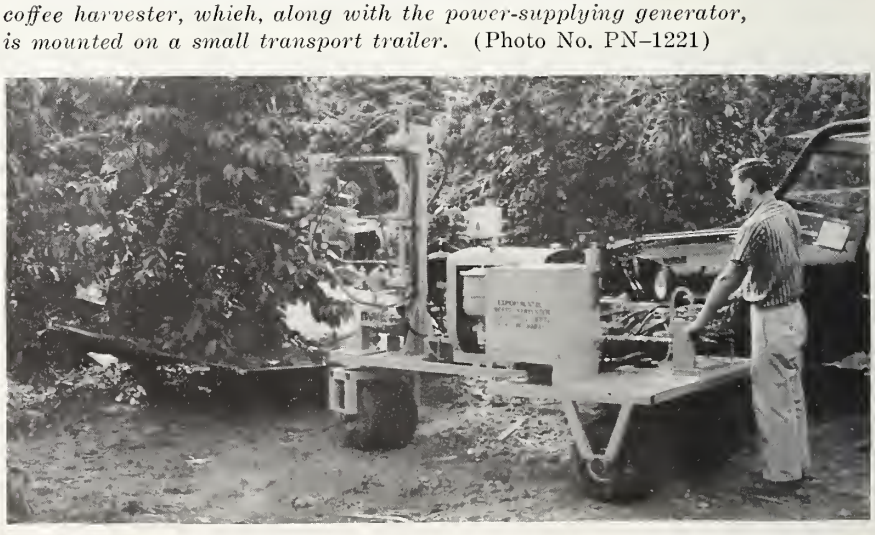
The unit that catches the fruit and conveys it into a container consists of two fabric fans that fold around the tree, a small motor, a blower, a suction hose, and a stilling tank. As the fruit falls from the tree, it lands on the fans and rolls to a low point, where it is sucked through the hose into the stilling tank.

The engineers say the shaker and fruit-catching units have clearly demonstrated the feasibility of an integrated system (there are now two separate units) for coffee harvesting. The equipment, still experimental, is not available commercially.

To make best use of the machinery, the engineers think that coffee-growing practices may have to be modified. These modifications could vary from minor pruning and orchard-floor cleanup to severe pruning and removal of trees that impede movement of the machines.☆

The catching frame, which folds around the tree, is mounted on a long boom attached to the front of a jeep. (Photo No. PN–1220)

Agricultural engineer Monroe operates a self-propelled coffee harvester, which, along with the power-supplying generator, is mounted on a small transport trailer. (Photo No. PN–1221)



Hormone reduces visceral leukosis

Dipping hatching eggs in testosterone (a male hormone) makes it much less likely that the chickens produced will come down with visceral leukosis, ARS research shows.

But the dipping also reduces hatchability, and therefore offers little relief to the poultryman beset by the costly inroads of this tumor-forming poultry disease. Commonly called "big liver disease," this illness is one of the major types of avian leukosis.

As reported previously (AGR. RES., July 1964, p. 5), surgical removal of the bursa gland largely eliminates a chick's chances of succumbing to visceral leukosis. Except for this resistance to visceral leukosis, bursa-less chickens are much like normal chickens and are still susceptible to other types of leukosis.

Surgery, of course, is a costly, time-consuming way to prevent visceral leukosis—effective as it is. So poultry biologist B. L. Burmester and his staff at the Regional Poultry Research Laboratory, East Lansing, Mich., have been searching for simpler methods to get rid of the bursa. This led to the testosterone trials.

Two-thirds of the chicks hatched from eggs dipped in testosterone propionate developed no bursa gland. And even though these chicks were from a laboratory strain that is highly susceptible to the disease, all but one successfully resisted the visceral leukosis virus when inoculated by syringe.

This laboratory strain normally has a low record of hatchability—an average of about 69 percent. And dipping eggs with testosterone reduces hatchability even further; only 21 to 39 percent of the dipped eggs hatched.

Even though testosterone dipping cannot be exploited economically, Burmester is investigating other ways to combat visceral leukosis. Most promising at present is a testosterone injection, which appears to cause the bursa of newly hatched chicks to atrophy, or wither away. Whether this alternative is practical still remains to be seen.

Starvation test for diapause

Boll weevils must pass a severe "starvation test" to be accepted for ARS hibernation studies in South Carolina.

Entomologists E. R. Mitchell and H. M. Taft, working with the South Carolina Agricultural Experiment Station at Florence, starve the weevils to determine which ones are in diapause. Most of those in diapause live through the starvation periods; the others die.

Large numbers of diapausing weevils are needed for research. Diapause, somewhat comparable to hibernation in mammals, is a phase in the life cycle of many insects in which life processes are temporarily retarded. This phase enables the boll weevil to survive the winter. Earlier investigations of weevil survival were hampered because so many field-collected insects were not diapausing and did not live through the winter. The new method assures a good supply of the required insects.

Mitchell and Taft collect large numbers of weevils in the field during September or October and keep them without food at approximately 74 degrees F. The maximum starvation periods are 3 weeks for insects collected in September and 1 week for those collected in October.

Soil sensor detects salinity

A new sensing instrument, placed in soil at various locations within a field, will determine salinity buildup in a plant's root zone without disturbing either the soil or plant roots.

This sensor, developed by an ARS physicist, is more than a time- and cost-saving research tool. It can help engineers in an irrigation district, for instance, decide when to apply leaching to reduce salinity.

Designed by L. A. Richards of the U.S. Salinity Laboratory, Riverside, Calif., the sensor checks soil salinity by measuring the electrical conductivity of soil moisture. The sensors are placed below plow depth or in areas of a field that are not tilled.

The heart of the unit is a fine-grained ceramic block, about 6 by 6 by 1 millimeter thick, having a platinum-screen electrode on each side. When the block contacts the soil and adsorbs moisture, the electrodes measure the moisture's electrical conductivity. The greater this conductivity, the more saline is the soil moisture.

Because the sensor is buried and constantly in contact with soil moisture, it provides a continuous record of the amount and fluctuation of soil salinity. This helps researchers compare different methods of combating salinity buildup.

Previously, soil scientists determined salinity by taking samples for laboratory analysis—a costly and inconvenient practice. Now they can install sensors permanently at different depths in the soil and at different locations in the crop. Data collection may be simplified by connecting all the sensors to recorders at a single location to make a continuous measurement of salinity.

UNITED STATES GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS, WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE TO AVOID
PAYMENT OF POSTAGE, $300
(GPO)

AGRISEARCH NOTES

A new clutch for industry

Engineers at the Southern utilization research laboratory have developed a reversible double-drive clutch that simplifies driving separate mechanical devices alternately.

Designed for use with the laboratory's new cotton blender (p. 13, this issue), the clutch already has been put to use by a manufacturer of oilfield machinery. It may also find applications in agricultural machinery.

The clutch was developed by L. P. Lanigan, Jr., E. F. Wallace, J. I. Kotter, and H. L. Salaun, Jr., to transmit high torque (twisting force) at low speeds with no loss of mechanical efficiency, but it can be modified for use with any power-torque ratio.

The unit requires only a single reversible power source and eliminates the need for a transmission.

The clutch is covered by public service patent No. 3,158,244, and licenses for manufacture may be obtained on a non-exclusive, royalty-free basis by writing to: Research Agreements and Patents, U.S. Department of Agriculture, Room 530, Federal Center Building, Hyattsville, Md., 20781.

Tick transmits African swine fever

How African swine fever (ASF) is transmitted to domestic hogs from wild animals that can carry the disease, yet not be affected by it, has been a mystery for several years. ARS scientists working at the East African Veterinary Research Organization, Kikuyu, Kenya, have shed some light on the mystery.

Experiments conducted by W. P. Heuschele and Leroy Coggins show that the Argasidae tick, *Ornithodoros moubata*, is capable of transmitting ASF from one domestic hog to another. This tick, also a carrier of human relapsing fever, is commonly found in homes, piggeries, and burrows of wart hog, porcupine, and aardvark.

In these tests, Heuschele and Coggins placed Argasidae ticks on an experimentally infected hog, where they were allowed to feed. Then, the ticks were transferred to other domestic hogs kept in isolated buildings. The ticks transmitted the disease to susceptible hogs in 2 of 8 trials.

Although the tests involved only domestic hogs, the scientists believe that a similar transmission may take place between wild and domestic hogs during some natural outbreaks. ASF spreads among domestic hogs through contact. But most attempts to infect domestic hogs by housing them with wart hogs, wild relatives that are unaffected carriers of the disease have failed.

As part of their Kenya experiments, Heuschele and Coggins collected Argasidae ticks from an area where 8 of 13 wart hogs were ASF carriers. Of the 8 carriers, only 3 had ASF virus in their blood, while the other 5 had the virus in lymph nodes or spleens.

The scientists tested a random sample of these ticks and found them free of ASF virus. This may be due to the fact that only a small number of wart hogs in the area had virus in their blood at collection time.

Although *Ornithodoros moubata* is a demonstrated ASF carrier, the scientists believe that it is not the only tick capable of spreading the disease. They note that Spanish scientists, financed by a USDA grant, found another tick—*Ornithodoros erraticus*—capable of harboring ASF virus as long as 12 months after taking a blood meal from an ASF-infected hog (AGR. RES., March 1965, p. 8).

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

U.S. GOVERNMENT PRINTING OFFICE: 1965